1. What are the *possible Rational* roots of the polynomial below?

$$f(x) = 4x^4 + 6x^3 + 5x^2 + 4x + 3$$

   A. All combinations of: $\dfrac{\pm 1, \pm 3}{\pm 1, \pm 2, \pm 4}$

   B. $\pm 1, \pm 3$

   C. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 3}$

   D. $\pm 1, \pm 2, \pm 4$

   E. There is no formula or theorem that tells us all possible Rational roots.

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2. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{20x^3 - 60x + 44}{x + 2}$$

   A. $a \in [19, 22], b \in [-62, -58], c \in [115, 129]$, and $r \in [-316, -315]$.

   B. $a \in [19, 22], b \in [-41, -38], c \in [16, 27]$, and $r \in [2, 5]$.

   C. $a \in [-41, -34], b \in [-82, -79], c \in [-222, -212]$, and $r \in [-396, -391]$.

   D. $a \in [-41, -34], b \in [74, 87], c \in [-222, -212]$, and $r \in [478, 485]$.

   E. $a \in [19, 22], b \in [37, 41], c \in [16, 27]$, and $r \in [81, 89]$.

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3. Factor the polynomial below completely, knowing that $x + 5$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 15x^4 + 151x^3 + 429x^2 + 185x - 300$$

   A. $z_1 \in [-0.52, 0.32]$, $z_2 \in [3.14, 4.93], z_3 \in [4.85, 5.74]$, and $z_4 \in [4.91, 6.54]$

   B. $z_1 \in [-5.08, -4.82]$, $z_2 \in [-4.33, -2.95], z_3 \in [-1.8, -1.17]$, and $z_4 \in [0.44, 1.16]$

C. $z_1 \in [-1.83, -1.54]$, $z_2 \in [0.34, 0.99]$, $z_3 \in [3.09, 4.44]$, and $z_4 \in [4.91, 6.54]$

D. $z_1 \in [-5.08, -4.82]$, $z_2 \in [-4.33, -2.95]$, $z_3 \in [-0.77, -0.17]$, and $z_4 \in [0.89, 2.04]$

E. $z_1 \in [-1.07, -0.25]$, $z_2 \in [1.41, 2.22]$, $z_3 \in [3.09, 4.44]$, and $z_4 \in [4.91, 6.54]$

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4. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 12x^3 + 11x^2 - 45x - 50$$

A. $z_1 \in [-0.89, -0.61]$, $z_2 \in [-0.68, -0.46]$, and $z_3 \in [1.96, 2.53]$

B. $z_1 \in [-1.84, -1.27]$, $z_2 \in [-1.31, -1.2]$, and $z_3 \in [1.96, 2.53]$

C. $z_1 \in [-2.26, -1.88]$, $z_2 \in [0.35, 0.54]$, and $z_3 \in [4.65, 5.07]$

D. $z_1 \in [-2.26, -1.88]$, $z_2 \in [0.45, 0.67]$, and $z_3 \in [0.65, 0.85]$

E. $z_1 \in [-2.26, -1.88]$, $z_2 \in [1.12, 1.42]$, and $z_3 \in [1.03, 1.93]$

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5. Factor the polynomial below completely. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 10x^3 + x^2 - 77x + 30$$

A. $z_1 \in [-2.06, -1.86]$, $z_2 \in [-0.7, -0.5]$, and $z_3 \in [2.63, 3.17]$

B. $z_1 \in [-3.19, -2.73]$, $z_2 \in [0.32, 0.41]$, and $z_3 \in [2.14, 2.85]$

C. $z_1 \in [-3.19, -2.73]$, $z_2 \in [0.32, 0.41]$, and $z_3 \in [2.14, 2.85]$

D. $z_1 \in [-2.57, -2.12]$, $z_2 \in [-0.48, -0.3]$, and $z_3 \in [2.63, 3.17]$

E. $z_1 \in [-2.57, -2.12]$, $z_2 \in [-0.48, -0.3]$, and $z_3 \in [2.63, 3.17]$

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6. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{15x^3 + 65x^2 + 90x + 37}{x + 2}$$

A. $a \in [15, 20],\ b \in [19, 21],\ c \in [30, 31],$ and $r \in [-56, -46]$.

B. $a \in [15, 20],\ b \in [35, 38],\ c \in [16, 22],$ and $r \in [-4, -2]$.

C. $a \in [15, 20],\ b \in [90, 97],\ c \in [280, 281],$ and $r \in [588, 607]$.

D. $a \in [-32, -28],\ b \in [124, 127],\ c \in [-163, -157],$ and $r \in [356, 359]$.

E. $a \in [-32, -28],\ b \in [4, 6],\ c \in [96, 103],$ and $r \in [227, 239]$.

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7. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{6x^3 + 27x^2 + 39x + 23}{x + 2}$$

A. $a \in [-14, -8],\ b \in [46, 55],\ c \in [-64, -57],$ and $r \in [149, 153]$.

B. $a \in [1, 10],\ b \in [39, 40],\ c \in [116, 119],$ and $r \in [253, 263]$.

C. $a \in [-14, -8],\ b \in [3, 5],\ c \in [41, 48],$ and $r \in [111, 118]$.

D. $a \in [1, 10],\ b \in [9, 13],\ c \in [12, 14],$ and $r \in [-14, -7]$.

E. $a \in [1, 10],\ b \in [15, 24],\ c \in [3, 10],$ and $r \in [2, 12]$.

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8. Perform the division below. Then, find the intervals that correspond to the quotient in the form $ax^2 + bx + c$ and remainder r.

$$\frac{12x^3 - 65x^2 + 120}{x - 5}$$

A. $a \in [11, 16], b \in [-8, -1], c \in [-27, -21],$ and $r \in [-7, -1]$.

B. $a \in [11, 16], b \in [-125, -124], c \in [617, 628],$ and $r \in [-3013, -3003]$.

C. $a \in [60, 65], b \in [-369, -364], c \in [1819, 1828],$ and $r \in [-9010, -9000]$.

D. $a \in [11, 16], b \in [-19, -16], c \in [-69, -67]$, and $r \in [-152, -149]$.

E. $a \in [60, 65], b \in [235, 241], c \in [1174, 1176]$, and $r \in [5995, 5996]$.

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9. Factor the polynomial below completely, knowing that $x - 3$ is a factor. Then, choose the intervals the zeros of the polynomial belong to, where $z_1 \leq z_2 \leq z_3 \leq z_4$. *To make the problem easier, all zeros are between -5 and 5.*

$$f(x) = 16x^4 - 112x^3 + 167x^2 + 175x - 300$$

A. $z_1 \in [-4.63, -3.96]$, $z_2 \in [-3.23, -2.25], z_3 \in [-1.08, -0.54]$, and $z_4 \in [0.18, 1.04]$

B. $z_1 \in [-0.98, -0.53]$, $z_2 \in [-0.07, 0.93], z_3 \in [2.84, 3.28]$, and $z_4 \in [3.16, 4.57]$

C. $z_1 \in [-4.63, -3.96]$, $z_2 \in [-3.23, -2.25], z_3 \in [-0.48, 0.1]$, and $z_4 \in [4.77, 5.57]$

D. $z_1 \in [-4.63, -3.96]$, $z_2 \in [-3.23, -2.25], z_3 \in [-1.68, -1.22]$, and $z_4 \in [0.94, 1.37]$

E. $z_1 \in [-1.71, -1.18]$, $z_2 \in [1.2, 2.35], z_3 \in [2.84, 3.28]$, and $z_4 \in [3.16, 4.57]$

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10. What are the *possible Rational* roots of the polynomial below?

$$f(x) = 2x^3 + 7x^2 + 7x + 4$$

A. $\pm 1, \pm 2, \pm 4$

B. All combinations of: $\dfrac{\pm 1, \pm 2}{\pm 1, \pm 2, \pm 4}$

C. All combinations of: $\dfrac{\pm 1, \pm 2, \pm 4}{\pm 1, \pm 2}$

D. $\pm 1, \pm 2$

E. There is no formula or theorem that tells us all possible Rational roots.
